



ZEBRA

15.250 IMPULSE RADIO COEXISTENCE REQUIREMENTS

EX-PARTE PRESENTATION IN RESPONSE TO NPRM FCC 18-147

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Proposed agenda

The Zebra UWB solution

- Used widely
- Deployed for years
- Including worker safety and NFL applications

Why proposed NPRM RLAN power levels are excessive

- Current proposed power levels cause interference at great range and area

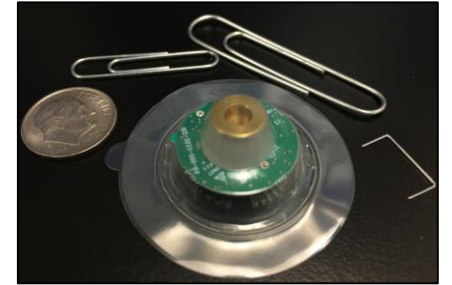
Zebra's proposed coexistence suggestions

- Lower allowed RLAN power
- If allowing higher power, limit that to the “low end”

Zebra's UWB solution is deployed at all NFL venues

Zebra UWB solution is the sole player tracking solution for NFL

- Every game-day venue (31 USA venues plus UK and Mexico)
- Every game all-season long
- In every game, every player, every official, every ball
- Every 1/10th of a second
- In our 5th season with NFL



Zebra solution is also used by 1/3rd of teams to track practices



Zebra's UWB solution tracks worker safety at Boeing

Awarded Boeing 2014 Supplier of the Year award

Ensure workers are "clipped-in" to prevent falls

- Painters are 30+ feet from concrete floor
- Track workers in 3 dimensions
- More than a dozen locations



Zebra's UWB solution used in US manufacturing

Used by major manufacturers

- Has been used for 5+ years
- Numerous customers
- Numerous locations



UWB solution offers unique attributes not found in other solutions

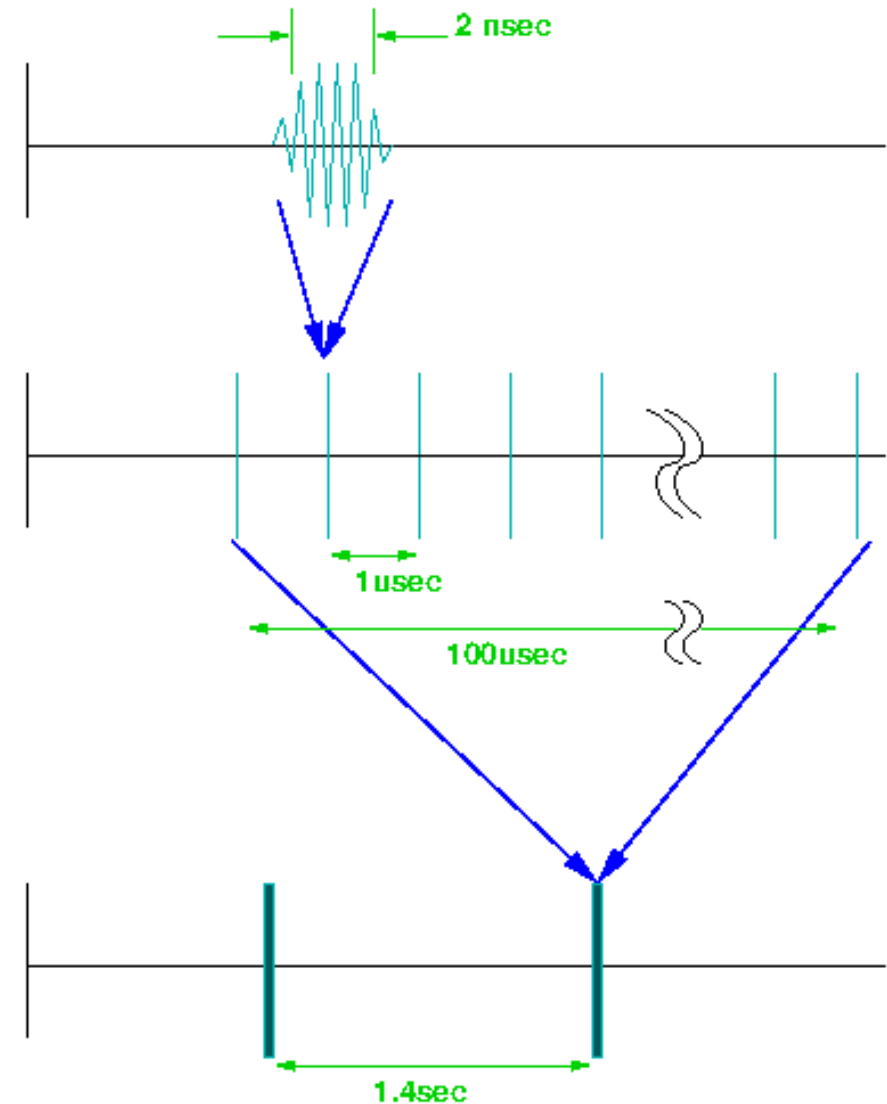
Timing accuracy of ~1 nSec

Can accommodate ~8000 locates/sec

Low power = small tags

- Micro-power transmitters
- Peak ~30mW
- 15.250 peak and average limits

Makes efficient use of spectrum AND power



Our customer use cases could not be solved any other way

Physically small tags

Able to run on a non-rechargeable battery

Able to run 1 year without replacement

Support ~8000 locates/sec (e.g.: NFL: 300 players, 2 tags each @ 12Hz)

At proposed power levels, Wi-Fi can interfere up to 1 mile (or more)

Wi-Fi would interfere at a great distance

- UWB solution is susceptible to interference from CW at $\sim -15\text{dB J/S}$
- At max UWB operating range, 1mW source would interfere
- NPRM with $+36\text{dBm}$ gives interference range ~ 1 mile even with 18 dB mitigation
- Micropower Tx critical for applications: Improvement of J/S is VERY inefficient

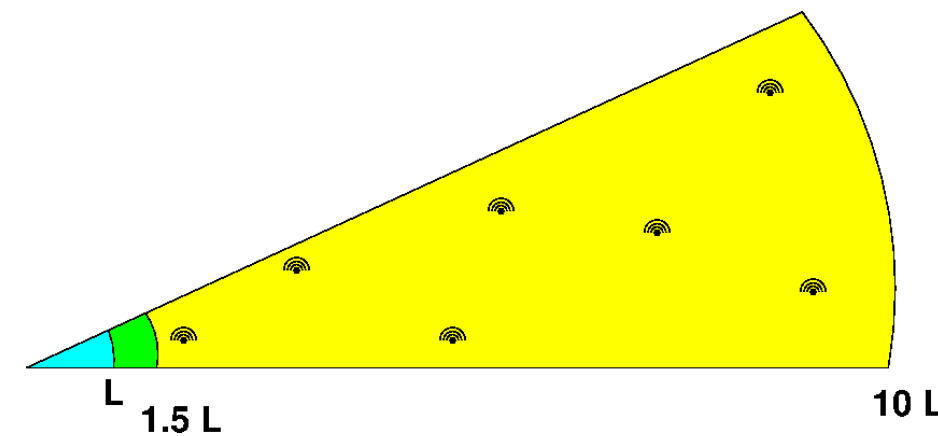


Area in which Wi-Fi interferer could reside is large

- As interference range increases, area of source increases by square
- High probability of interference in πR^2 when $R = 1$ mile !

Wi-Fi interferers would be “agile”

- Unpredictable, thus unable to filter
- Mobile Access Points are the worst-case example of this



No place else to go for unidirectional UWB solutions

15.250 permits one-way transmission outdoors only in 5925-7250 MHz

- Tx-only enables many applications requiring micro-power

15.517 limited to indoor only

- Many use cases require outdoor operation

15.519 requires two-way communication

- Adding Rx makes tags larger
- Shortens battery life and/or complicates power management
- Makes many RTLS use cases impractical

Zebra's coexistence suggestions: 1 of 2

Limit RLAN to ~30mW across most of 5925-7125

- 30mW is still a useful power level
- Enhances spatial re-use of RLAN
- Limits RLAN interference range for *all* services and technologies



Assumptions:

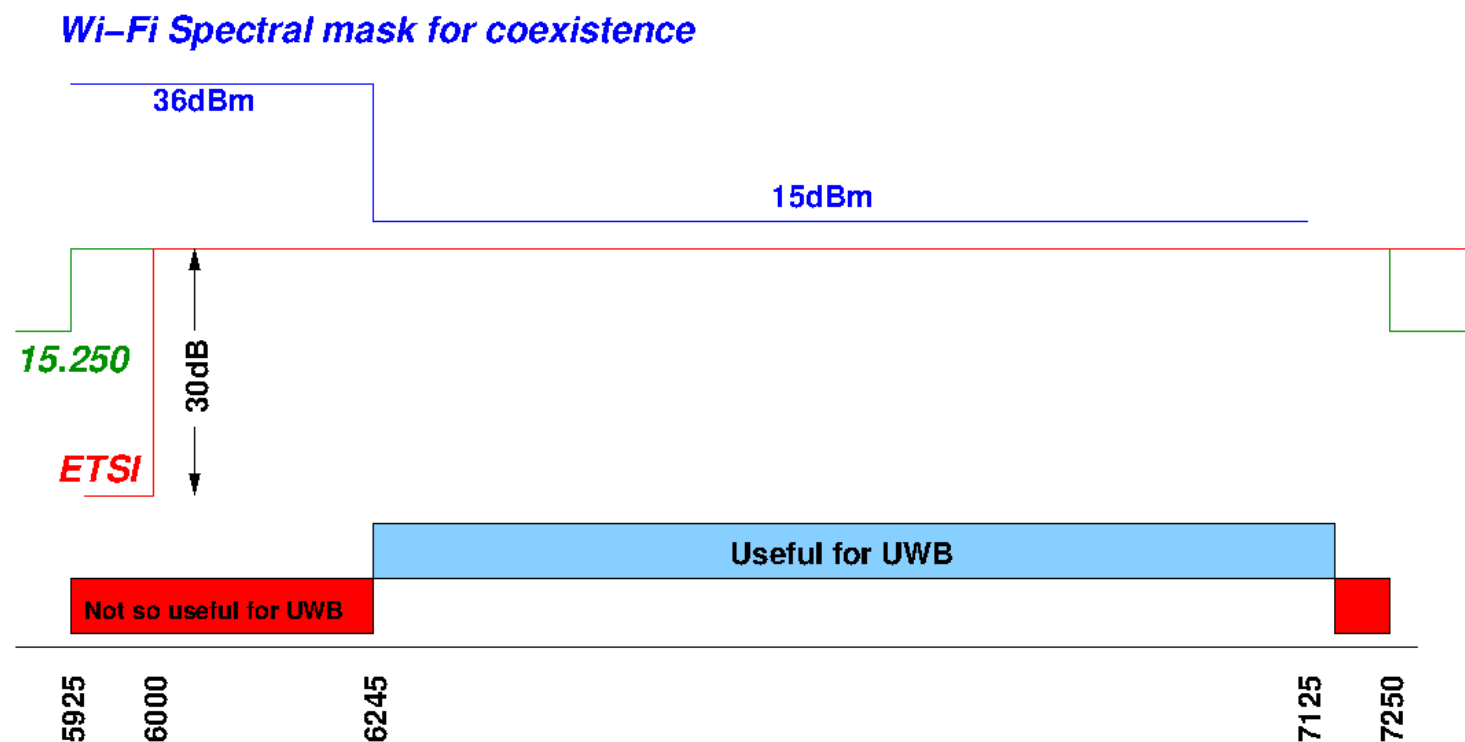
- UWB system “optimized” for region of size “L”
- Operator can (mostly) control in-venue environment
- 1mW EIRP at range “L” causes interference
- Nobody puts their access point on their perimeter – typical interference distance is 1.5L

Mitigation item:	Factor:	Tolerable EIRP:
On-site at range L	0 dB	1 mW
At range 1.5L, unobstructed, boresight	3.5 dB	2.25 mW
Terrain/obstruction at 1.5L	6 dB	9 mW
Antenna orientation	6 dB	36 mW

Zebra's coexistence suggestions: 2 of 2

If allowing higher RLAN powers, limit to low end: 5925-6245 MHz

- That “lower end” is not useful to UWB systems



Summarizing Zebra's suggestions

Essential: Prohibit Mobile Access Points

- There is no way to mitigate against mobile APs
- The logical conclusion of statements already in the NPRM prohibiting use in trains, planes, etc.

Suggestions for coexistence:

- Limit RLAN to ~30mW across most of 5925-7125
- If allowing higher RLAN power, only on low end: 5925-6245 MHz

Also consider:

- Industrial participation in AFC Database
- Provision for Exclusion Beacons